Day 10: Practical Social Media Data Mining

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Introduction to Data Science and Big Data Analytics

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Day 10 Outline

Practical Tools for Data Science

Social Media Data

Practical Tools for Data Science

Tools for Data Science: Categories of tools

- Programming languages
- Specialised libraries and packages within programming languages
- Graphical interfaces and visualization
- Online communities and code hosting, source control
- Big data, databases and parallelization
- Tools specifically for text analysis

Programming languages

- Statically typed:
  - C, C++, Java, Fortran, c
  - Slower to learn, slower to write in, faster to run
- Dynamically typed ('scripting')
  - : perl, python, ruby, javascript, php
- Data analysis
  - : R, matlab, octave

Data analysis software

- R and python currently most popular for data science
- Python: Pandas, NLTK, Scikit-learn
- R: CRAN and many small, custom packages
- Java: WEKA
- Graphical interfaces: Stata, SAS, SPSS

Systems, Text editors and IDEs

- Windows, Mac, or Linux
- vim and emacs
- notepad++, textmate, gedit, sublimetext, atom
- R: RStudio, RCommander, Revolution R
- Java: Eclipse, Netbeans
- Python: Spyder, PyCharm

Visualization

- R: ggplot2
- Python matplotlib
- Gephi: network visualization `http://gephi.github.io/`

Code hosting and source code management

- Version control/Source code management: git, mercurial, svn
- Hosting: github, bitbucket, gitlab
- github also serves as a community for discussion and collaboration

Resources for learning to code

- http://tryr.codeschool.com/
- https://www.coursera.org/course/programming1
- https://developers.google.com/edu/
- http://stackoverflow.com/
- http://stats.stackexchange.com/
- http://www.google.com/advanced_search

Big data and parallel and distributed processing

- ‘Big Data’ ill-defined, but should refer to data that can’t be processed in-memory on local machine
- This implies a changing definition
- Parallel processing: R package ‘parallel’
- Distributed processing: MapReduce with Hadoop, Apache spark
- Cloud computing
- Databases: Relational (e.g. SQL,) non-relational ’NoSQL’ (e.g. redis, cassandra)

Packages for quantitave text analysis

- Stanford CoreNLP, Mallet (Java)
- NLTK, gensim, TextBlob (Python)
- tm, quanteda (R)
- Alceste, WordStat (QDA Miner)
- Nvivo, atlas.ti

Books for text analysis

- Natural Language Processing with Python - NLTK
- Foundations of Statistical Natural Language Processing (Manning and Schutze)
- Introduction to Information Retrieval

Handling text data

- Usually less data-intensive than image, audio, or video
- ASCII, UTF-8: 1 byte per character ($2^7 = 128$ chars)
- E.g., entire proceedings of European Parliament, 1996-2005, in 21 languages [1]: 5.4GB
- Often the difficulty is $p >> n$, rather than 'big data'.

Scraping text from the web

- web crawlers/spider download sites by traversing links
- Python - scraPy, Beautiful Soup
- R - Rvest
- Chrome web plugins, import.io
- cUrl, wget, or other tools available ('httrack')
- Problems: rate limiting, ethical issues

Make scraping unnecessary!

- Organizations and governments should be aware of need for open, machine-readable data
- data.gov.uk, data.gov
- Data should be available in human and machine format!
- Make the raw data available in as many formats as possible.
- Consider machine readability at time of data collection
- Provide an Application Programming Interface (API)

Social Media Data

Why social media data?

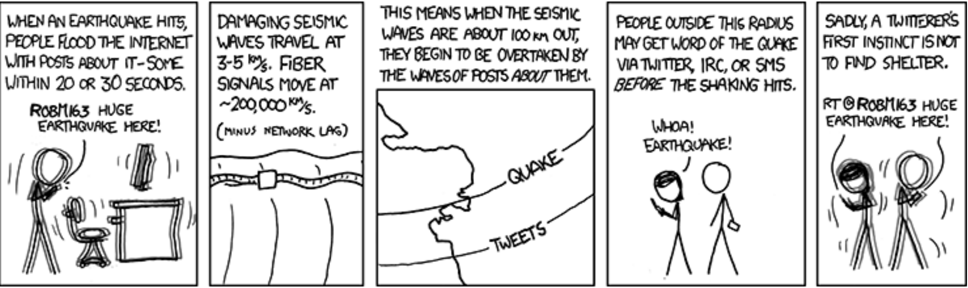
- Volume and coverage
- Twitter: 316 million monthly active users, 500m tweets per day [2]
- Facebook: 968 million daily active users on average for June 2015, 1.49 billion monthly active users as of June 30, 2015 [3]
- Real time — new data is available (somewhat) publicly immediately on current events
- Metadata — geographic location, user device, profile, timestamp and other metadata is accessible.

Why social media data?

- Good case for machine learning and data mining — lots of data, lots of metadata
- Many-to-many *broadcast* text corpus
- Social network analysis: a graph of social connections
- Passively sampling has some advantages over other survey methods

- Broadcast
  - simplex (e.g. radio, semaphore, smoke signal)
  - duplex (e.g. round-table meeting)
  - publish-subscribe (e.g. twitter, mailing list)
- Point-to-point: sender specifies receivers
- Social media allow many of these different forms of communication
- Twitter is broadcast publish-subscribe
- Every user is a sensor: receiver and broadcaster — a distributed sensor network [4]
- `https://www.youtube.com/watch?v=XJ1EQbmJ_LQ`

Seismic Waves



Why not?

- Legal, ethical and privacy concerns:
- twitter is relatively public, facebook relatively private
- legal issues need to catch up with the technology
- Are EULAs (End-User License Agreement) too complex to allow ‘informed consent’?
- A/B testing doesn’t need consent, should social experiments? ($N = 689{,}003$)[5]

Why not?

- Unconventional language use — slang, txtspk, emoticons :-(
- Sampling issues and many new methodological headaches: homographs
- Very difficult to interpret tweet frequencies: What causes someone to tweet?
- Biased sample (Barbera and Rivero 2013)
- commercial interfaces are brittle, inconsistent, opaque and present at challenge for replication

Privacy: example

- Example: FOI request for NYC taxi fare logs:
- Medallian numbers and cab numbers were mapped to unique ids with MD5 hash
- ids follow certain pattern, only 22M possible
- Can compute all hashes in 2 minutes [6]

Example applications

- Tracking disease (ILI) through search terms and social media (Lampos et al 2015)
  - Geo-located tweets for 154 weeks
  - Manual list (dictionary) of 36 ngrams (up to 4grams) that were associated with illness, expanded to 205 with co-occurrence matching
  - To measure level of illness and association with vaccination program
  - Regularized linear regression, X is ngrams frequencies, Y is health statistics

Example applications

- Predicting election outcomes or polls
- Sentiment: particularly for financial or corporate interests
- (Vasileios Lampos: www.lampos.net)
- Government security/intelligence
- Social network analysis: a graph of social connections

How can we access this data?

- API: Application Programming Interface — a way for two pieces of software to talk to each other
- Twitter, facebook, google — all expose public web services
- Your software can receive (and also send) data automatically through these services
- Data is sent by `http` — the same way your browser does it
- Most services have helping code (known as a wrapper) to construct http requests
- both the wrapper and the service itself are called APIs
- http service also sometimes known as REST (REpresentational State Transfer)

HyperText Transfer Protocol

Anatomy of a http request

`https://api.twitter.com/1.1/search/tweets.json?`
`q=Nick+Clegg%21&since_id=24012619984051000&max_id=25012619`

`Nick Clegg!` becomes `Nick+Clegg%21`

- Parameters to the API are encoded in the URL
- you must encode requests — spaces and non ASCII characters are replaced

Available social media APIs

- Wikipedia: mediawiki
- Google
- google plus
- blogger
- reddit
- foursquare
- facebook
- twitter: 'Gardenhose' (REST, Streaming), firehose, commercial

The twitter APIs: REST

- This is the most comprehensive API
- Returns a sample of historical data from the last 8–10 days.
- Stateless: you send a command and receive a result.
- http GET requests return information
- http POST requests upload or alter information (e.g. twitterbots)
- The manual: `https://dev.twitter.com/rest/public`
- R package : twitteR

The twitter APIs: Streaming

- Connect to the twitter server and collect tweets as they fly by.
- The manual:
  `https://dev.twitter.com/streaming/public`
- R package: streamR

Authentication

- Username and Password
- Oauth (ROauth): share a key without sharing a username and password
- IP address limitations
- Rate limitations
- Per-user and per-application

Other options

- The firehose: work with twitter
- Commercial options: GNIP (now bought by twitter) and Datasift

The Output: JSON and XML

- XML: eXtensible Markup Language: encodes documents in a form that is both human-readable and machine readable
- JSON : JavaScript Object Notation
- If you have a choice, you probably want JSON
- JSON uses key:value pairs, XML uses trees
- JSON is easily read into a programming language
- Sometimes known as serialization formats

And finally... the data.

- Full of spam, bots, unicode, and gibberish
- Homographs and ambiguities are a problem, e.g. Clegg, Cameron, Miliband
- Lots of retweets (approximately one-third retweets, replies, tweets)
- Only 1% show location — some methods exist to infer location
- All aspects of metadata and reply/retweet structure are available
- All aspects of network structure: followers and ‘friends’, profile information

Twitterbots

- API also allows actions such as posting tweets (POST)
- Examples:
- @netflix_bot posts new content using netflix api
- @eqbot posts earthquake warnings
- @pentametron posts pairs of tweets in rhyming couplets [7]

Twitterbots


Big Ben
@big_ben_clock

BONG BONG BONG BONG BONG BONG BONG BONG BONG BONG

10:00 AM - 10 Oct 2014

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